# TFF1015HN/N1

## Integrated mixer oscillator PLL for satellite LNB

Rev. 1 — 12 September 2011 Product data sheet

## 1. General description

The TFF1015HN/N1 is an integrated downconverter for use in Low Noise Block (LNB) convertors in a 10.7 GHz to 12.75 GHz $K_u$ band satellite receiver system.

## 2. Features and benefits

- Low current consumption integrated pre-amplifier, mixer, buffer amplifier and PLL synthesizer
- Flat gain over frequency
- Single 5 V supply pin
- Low cost 25 MHz crystal
- Crystal controlled LO frequency generation
- Switched LO frequency (9.75 GHz and 10.6 GHz)
- Low phase noise
- Low spurious
- Low external component count
- Alignment-free concept
- ESD protection on all pins

## 3. Applications

- $K_u$ band LNB converters for digital satellite reception (DVB-S / DVB-S2)

## 4. Quick reference data

**Table 1. Quick reference data**

*$V_{CC}$ = 5 V; $T_{amb}$ = 25 °C; $f_{LO}$ = 9.75 GHz or 10.6 GHz; $f_{xtal}$ = 25 MHz; $Z_0$ = 50 Ω unless otherwise specified.*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{CC}$ | supply voltage | | 4.5 | 5 | 5.5 | V |
| $I_{CC}$ | supply current | RF input and IF output AC coupled | - | 52 | - | mA |
| $NF_{SSB}$ | single sideband noise figure | measured at low band $f_{IF}$ = 1450 MHz and high band $f_{IF}$ = 1625 MHz | - | 7 | - | dB |
| $f_{i(RF)}$ | RF input frequency | low band | 10.7 | - | 11.7 | GHz |
| | | high band | 11.7 | - | 12.75 | GHz |
| $G_{conv}$ | conversion gain | measured at low band $f_{IF}$ = 1450 MHz and high band $f_{IF}$ = 1625 MHz | - | 39 | - | dB |

**Table 1. Quick reference data** *...continued*

*$V_{CC}$ = 5 V; $T_{amb}$ = 25 °C; $f_{LO}$ = 9.75 GHz or 10.6 GHz; $f_{xtal}$ = 25 MHz; $Z_0$ = 50 Ω unless otherwise specified.*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $s_{11}$ | input reflection coefficient | $f_{RF}$ = 10.7 GHz to 12.7 GHz | - | −10 | - | dB |
| $s_{22}$ | output reflection coefficient | $f_{IF\_OUT}$ = 950 MHz to 2150 MHz; $Z_0$ = 75 Ω | - | −10 | - | dB |
| $IP3_O$ | output third-order intercept point | carrier power is −10 dBm (measured at output) | - | 15 | - | dBm |

## 5. Ordering information

**Table 2. Ordering information**

| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| TFF1015HN/N1 | DHVQFN16 | plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 16 terminals; body 2.5 × 3.5 × 0.85 mm | SOT763-1 |

## 6. Block diagram

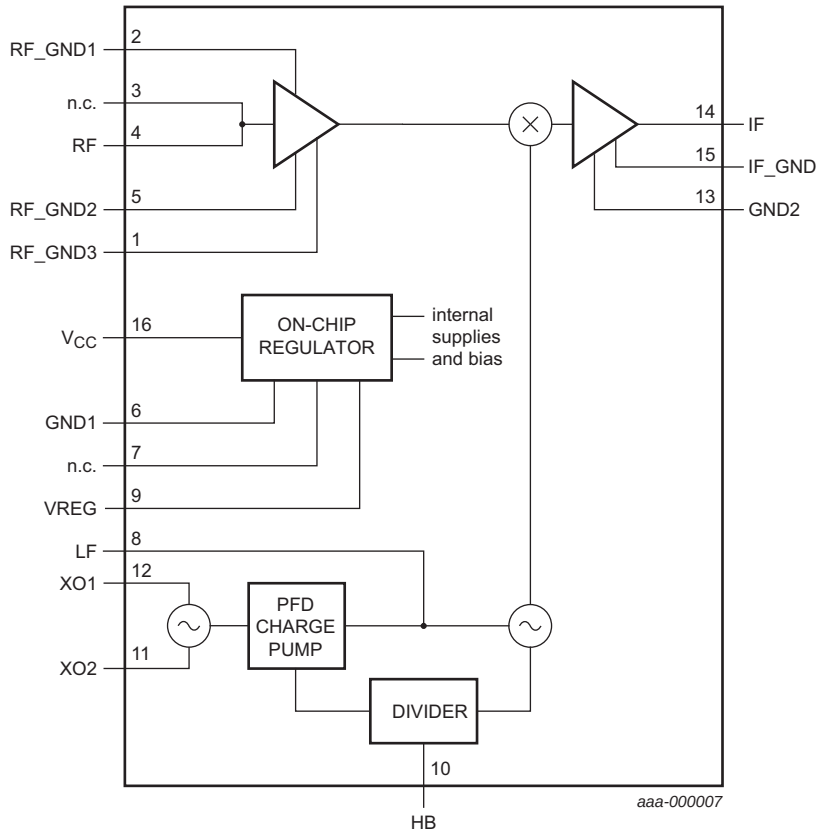



**Fig 1. TFF1015HN/N1 block diagram**

# 7. Functional diagram

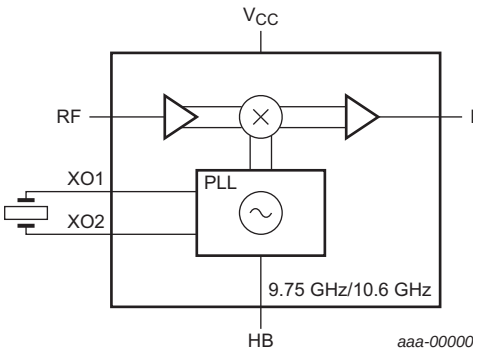



**Fig 2. Functional diagram**

# 8. Pinning information

## 8.1 Pinning

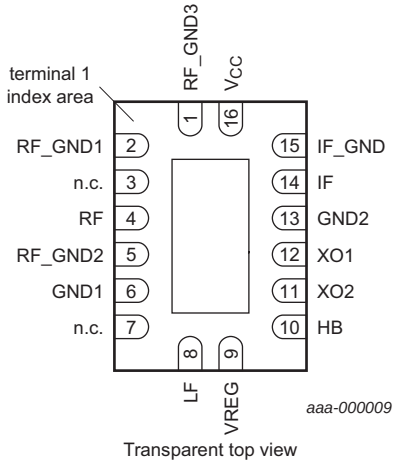



**Fig 3. Pin configuration**

## 8.2 Pin description

**Table 3. Pin description**

| Symbol | Pin | Description |
|---|---|---|
| GND | 0 | ground (exposed die pad) |
| RF_GND3 | 1 | RF ground. Connect this pin to the exposed die pad landing. |
| RF_GND1 | 2 | RF ground. Connect this pin to the exposed die pad landing and the RF input CPW line. |
| n.c. | 3 | not connected. Connect to RF on PCB. [1] |
| RF | 4 | RF input. |
| RF_GND2 | 5 | RF ground. Connect this pin to the exposed die pad landing and the RF input CPW line. |

**Table 3. Pin description** *...continued*

| Symbol | Pin | Description |
|---|---|---|
| GND1 | 6 | Ground. Connect this pin to the exposed die pad landing and the RF input CPW line. |
| n.c. | 7 | not connected. Use this pin to route the ground layer on top of the PCB to the exposed die pad. |
| LF | 8 | Loop filter PLL. Connect loop filter between this pin and VREG (pin 9). |
| VREG | 9 | Regulated output voltage for PLL loop filter. Connect loop filter to this pin. Decouple against die pad via pin 7. |
| HB | 10 | High band / low band selection. Connect this pin to the tone detector or to a logic signal. |
| XO2 | 11 | Crystal connection 2. Connect crystal between this pin and XO1 (pin 12). |
| XO1 | 12 | Crystal connection 1. Connect crystal between this pin and XO2 (pin 11). |
| GND2 | 13 | Ground. Connect this pin to the exposed die pad landing. |
| IF | 14 | IF output |
| IF_GND | 15 | IF output ground. Connect this pin to the exposed die pad landing and the output transmission line ground. |
| $V_{CC}$ | 16 | Supply voltage |

[1] The distance between the outer edges of pin 2 and pin 3 is 740 μm. This gives an optimum transition from a 1.1 mm wide, $Z_0$ = 50 Ω line on RO4223 Printed-Circuit Board (PCB) material of 0.5 mm height to the TFF1015HN/N1.

## 9. Limiting values

**Table 4. Limiting values**

*In accordance with the Absolute Maximum Rating System (IEC 60134).*

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_{CC}$ | supply voltage | | −0.5 | +6 | V |
| $V_{I(HB)}$ | input voltage on pin HB | | −0.5 | +6 | V |
| $T_{stg}$ | storage temperature | | −40 | +125 | °C |

## 10. Recommended operating conditions

**Table 5. Operating conditions**

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{CC}$ | supply voltage | | 4.5 | 5 | 5.5 | V |
| $V_{I(HB)}$ | input voltage on pin HB | | 0 | - | 5.5 | V |
| $T_{amb}$ | ambient temperature | | −40 | +25 | +85 | °C |
| $Z_0$ | characteristic impedance | | - | 50 | - | Ω |
| $f_{i(RF)}$ | RF input frequency | low band | 10.7 | - | 11.7 | GHz |
| | | high band | 11.7 | - | 12.75 | GHz |
| $f_{LO}$ | LO frequency | low band | - | 9.75 | - | GHz |
| | | high band [1] | - | 10.6 | - | GHz |
| $f_{o(IF)}$ | IF output frequency | low band | 0.95 | - | 1.95 | GHz |
| | | high band | 1.1 | - | 2.15 | GHz |
| $C_{L(xtal)}$ | crystal load capacitance | | - | 10 | - | pF |
| ESR | equivalent series resistance | | - | - | 40 | Ω |
| $f_{xtal}$ | crystal frequency | | - | 25 | - | MHz |

[1] For a 10.75 GHz LO frequency, select high band and use a crystal with frequency 10.75 GHz / 424 = 25.353774 MHz.

## 11. Thermal characteristics

**Table 6. Thermal characteristics**

| Symbol | Parameter | Conditions | Typ | Unit |
|---|---|---|---|---|
| $R_{th(j-c)}$ | thermal resistance from junction to case | | 35 | K/W |

## 12. Characteristics

**Table 7. Characteristics**

*$V_{CC}$ = 5 V; $T_{amb}$ = 25 °C; $f_{LO}$ = 9.75 GHz or 10.6 GHz; $f_{xtal}$ = 25 MHz; $Z_0$ = 50 Ω unless otherwise specified.*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $I_{CC}$ | supply current | RF input and IF output AC coupled | - | 52 | - | mA |
| $\varphi_{n\lambda(itg)}$ | integrated phase noise density | integration offset frequency = 10 kHz to 13 MHz; loop bandwidth = crossover bandwidth | - | 1.5 | - | °RMS |
| $NF_{SSB}$ | single sideband noise figure | measured at low band $f_{IF}$ = 1450 MHz and high band $f_{IF}$ = 1625 MHz | - | 7 | - | dB |
| $G_{conv}$ | conversion gain | measured at low band $f_{IF}$ = 1450 MHz and high band $f_{IF}$ = 1625 MHz | - | 39 | - | dB |
| $\Delta G_{conv}$ | conversion gain variation | over whole IF band | - | 2.0 | - | dB |
| | | in every 36 MHz band | - | 0.5 | - | dB |
| $s_{11}$ | input reflection coefficient | $f_{RF}$ = 10.7 GHz to 12.7 GHz | - | −10 | - | dB |
| $s_{22}$ | output reflection coefficient | $f_{IF\_OUT}$ = 950 MHz to 2150 MHz; $Z_0$ = 75 Ω | - | −10 | - | dB |
| $IP3_O$ | output third-order intercept point | carrier power is −10 dBm (measured at the output) | - | 15 | - | dBm |
| $P_{L(1dB)}$ | output power at 1 dB gain compression | | - | 6 | - | dBm |
| $V_{IL(HB)}$ | low level input voltage on pin HB | | - | - | 0.8 | V |
| $V_{IH(HB)}$ | high level input voltage on pin HB | | 2.0 | - | - | V |
| $R_{pd(HB)}$ | pull down resistance on pin HB | | 80 | 110 | 140 | kΩ |

## 13. Application information

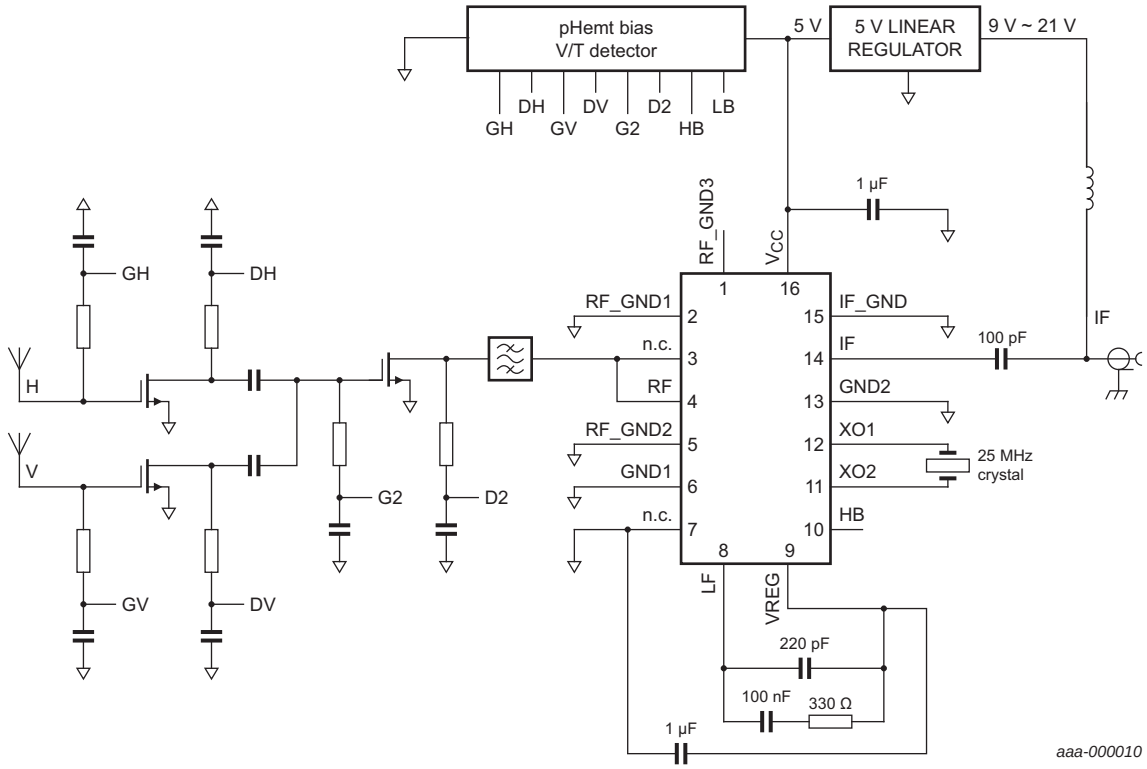



**Fig 4. Application diagram of TFF1015HN/N1**

**Table 8. List of netnames**

*See Figure 4.*

| Netname | Description |
|---|---|
| GH | Gate voltage of 1st stage LNA. Horizontal polarization |
| DH | Drain voltage of 1st stage LNA. Horizontal polarization |
| GV | Gate voltage of 1st stage LNA. Vertical polarization |
| DV | Drain voltage of 1st stage LNA. Vertical polarization |
| G2 | Gate voltage of 2nd stage LNA |
| D2 | Drain voltage of 2nd stage LNA |
| HB | High band oscillator supply control |
| LB | Low band oscillator supply control |

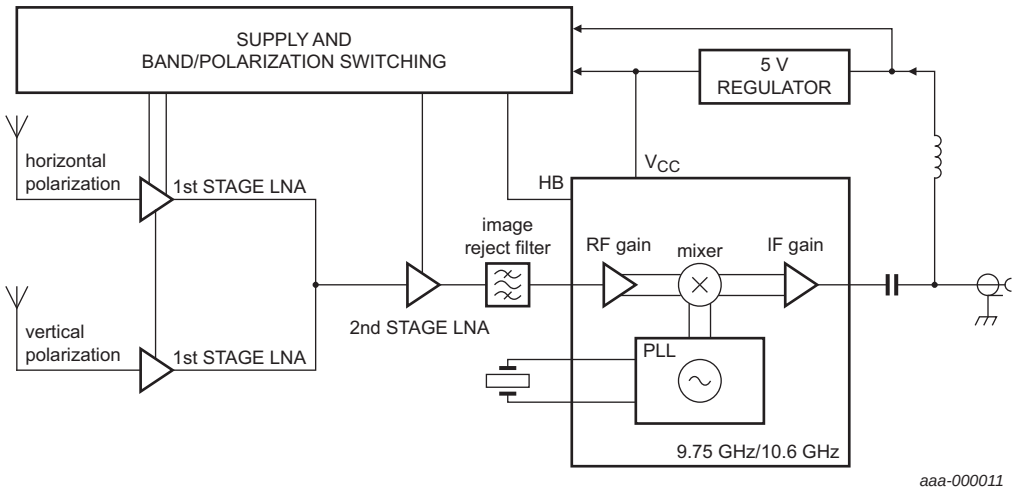
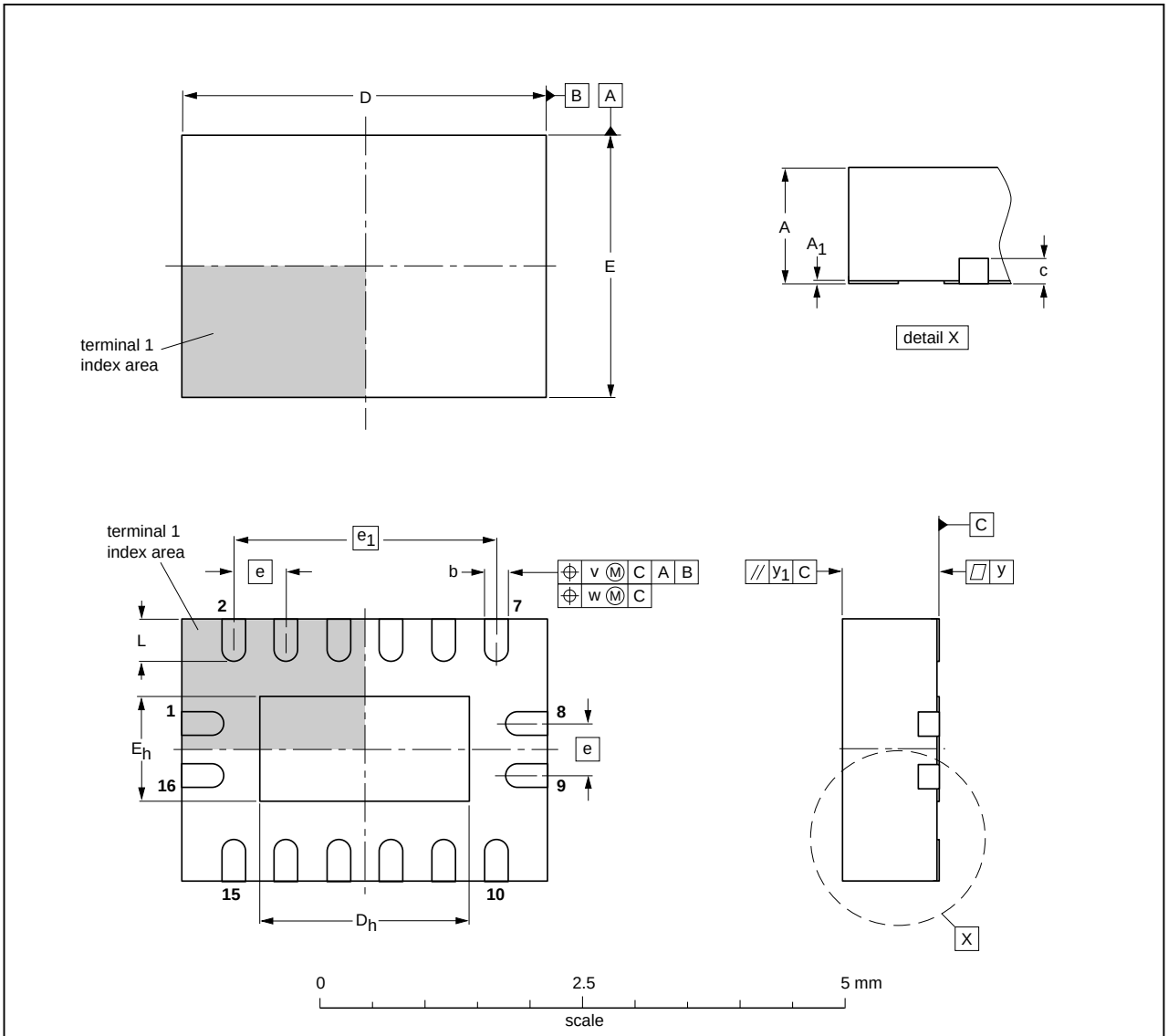



**Fig 5. LNB system block diagram with TFF1015HN/N1**

## 14. Package outline

**DHVQFN16: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 16 terminals; body 2.5 x 3.5 x 0.85 mm** **SOT763-1**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | $A^{(1)}$ max. | $A_1$ | b | c | $D^{(1)}$ | $D_h$ | $E^{(1)}$ | $E_h$ | e | $e_1$ | L | v | w | y | $y_1$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1 | 0.05<br>0.00 | 0.30<br>0.18 | 0.2 | 3.6<br>3.4 | 2.15<br>1.85 | 2.6<br>2.4 | 1.15<br>0.85 | 0.5 | 2.5 | 0.5<br>0.3 | 0.1 | 0.05 | 0.05 | 0.1 |

**Note**

1. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT763-1 | - - - | MO-241 | - - - | | | ~~02-10-17~~<br>03-01-27 |

**Fig 6. Package outline SOT763-1**

## 15. Abbreviations

**Table 9. Abbreviations**

| Acronym | Description |
|---|---|
| CPW | CoPlanar Waveguide |
| DVB-S | Digital Video Broadcasting by Satellite |
| DVB-S2 | Digital Video Broadcasting - Satellite - Second generation |
| ESD | ElectroStatic Discharge |
| IF | Intermediate Frequency |
| $K_u$ band | K-under band |
| LO | Local Oscillator |
| PFD | Phase Frequency Detector |
| pHemt | pseudomorphic High electron mobility transistor |
| PLL | Phase-Locked Loop |
| RF | Radio Frequency |
| VCO | Voltage-Controlled Oscillator |
| V/T | Voltage / Tone |

## 16. Revision history

**Table 10. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| TFF1015HN_N1 v.1 | 20110912 | Product data sheet | - | - |

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| Document status[1][2] | Product status[3] | Definition |
|---|---|---|
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